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The Recording Secretary read letters from Dr. Herrmann Hagen, acknowledging his election into the Academy, and from Dr. C. A. Martius, of Munich, announcing the death of his father, Dr. Carl Friedrich Philipp von Martius; also letters relative to exchanges, and a letter from a committee of the Suffolk District Medical Society, asking the co-operation of the Academy in discussing the subject of expert testimony. This communication was referred to a committee of the Academy appointed in March, 1866, to consider the same subject; and this committee were authorized to add to their number.

Professor E. C. Pickering made a communication on the Spectroscope, with experimental illustrations of its various constructions and its uses in chemistry and astronomy.

Six hundred and seventh Meeting.

April 13, 1869. — MONTHLY MEETING.

In the absence of the regular presiding officers, Mr. John A. Lowell was chosen to take the chair.

Mr. Ritchie exhibited some of the effects of monochromatic light by means of an apparatus producing a bright sodium light.

Six hundred and eighth Meeting.

May 11, 1869. — MONTHLY MEETING.

In the absence of the regular presiding officers, Hon. C. F. Adams was chosen to take the chair.

Professor Peirce made the following communication: —

The phenomena which were ably presented by the distinguished geologist, Mr. Lesley, to the National Academy of Sciences, and which seem to demonstrate that the outer shell of the earth has sensibly shrunk, in some directions at least, since its original formation, naturally invite the attention of physicists to the possible causes of such a result. The most obvious cause of the shrinking of the earth is its cooling. But to shrink two per cent linearly, which is that deduced by

Mr. Lesley from the observed geological phenomena, involves a probable cooling of the whole earth of not less than two thousand degrees centigrade, which would require that its original temperature should be higher than would be consistent with the solidity of these shrunk strata.

Another source of change of form, which would produce shrinkages in different directions in different parts of the earth, is to be found in the diminution of oblateness arising from the diminished velocity of rotation upon the axis. Such diminution of the velocity of rotation has several years ago been shown by Mr. Ferrel to be caused by the action of the moon in producing the tides; this is, therefore, a true cause, and it is only necessary to examine how great its amount can be under any circumstances. This is all which is proposed in the present investigation, and the application to facts is reserved for geologists.

It is sufficient, for the present object, to regard the earth as homogeneous. Under this condition Laplace has shown that the time of the earth's rotation could not be less than about one tenth of a day, which corresponds to a ratio of the axis of the equator to that of the pole, equal to 2.7197, and an equatorial circumference 94 per cent greater than the present one. Such is then the amount of shrinking which might have taken place, if any cause could be assigned capable of producing so great a reduction of the earth's velocity. The whole surface of the earth would have been about 130 per cent larger than at present.

But the only cause at present known which would produce a sensible reduction of the earth's velocity is the lunar action upon the tides. But in this mutual action between the moon and the earth, the common rotation area of the earth and moon must remain unchanged. The question then arises, How great a reduction of the rotation area of the earth would have passed into that of the moon? In this inquiry it may be assumed that the moon revolves in a circular orbit in the plane of the earth's equator. Now the moon's rotation area is 3.716 times the earth's. But if, in the origin, it had revolved just in contact with this earth, its rotation area would not have been less than 0.480 times the earth's, so that it could not have absorbed a rotation area from the earth greater than 3.236 times the earth's present rotation area, and therefore the earth's rotation area could never have exceeded 4.236 times that which it has at present. But, with the maximum velocity of rotation given by Laplace, the earth's rotation area would have been

37½ times greater than at present. It can never, therefore, have been reduced to so great an extent by the moon's action on the tides. But since, when the oblateness is small, the rotation area is nearly proportional to the velocity, and the excess of the square of the equatorial above that of the polar axis is nearly proportional to the square of the velocity, this excess may have been originally nearly 18 times as great as at present, or about 15½ per cent of the square of the polar axis. This would correspond to a figure of the earth in which the equatorial radius would have been about 2½ per cent greater than at present; so that it is sufficient to account for the observed phenomenon.

This peculiar form of shrinkage would produce the highest mountains at the equator, and the tendency of the mountain ranges would then be to assume the direction of the meridian. But nearer the poles the mountains would be less elevated, and would rather tend towards the direction of the parallels of latitude.

It is, next, expedient to consider the mechanical question of the loss of living force in the case of the moon's action upon the waters of the earth, and its effect upon their different motions. In this connection there are problems worthy of the attention of Geometers; such as the relative motions of bodies rotating above the same vertical axis, towards which they are drawn by weights, and acting upon each other through the friction on the axis. For one of the bodies a rotating wheel may be substituted. There is also the case of two planets revolving about a primary, and acting upon each other through some form of friction.

In this way, it will be seen that the planet or satellite once formed is constantly removed from the primary, and that planets tend to approach each other. It is interesting to consider whether this may not be one of the actual problems of nature.

Six hundred and ninth Meeting.

May 25, 1869. — ANNUAL MEETING.

In the absence of the regular presiding officers, Hon. Robert C. Winthrop was chosen to take the chair.

The Chairman called the attention of the Academy to the recent decease of Hon. William Mitchell and of Dr. William Allen, both of them Resident Fellows.